Life Cycle Assessment of Tetra Recart Cartons and Alternative Soup Containers on the U.S. Market

July 2014

FRANKLIN Associates
A Division of ERG
Presentation Overview

1. LCA Methodology
2. Soup Packaging LCA Goal & Scope
3. Soup Packaging LCA Results
   - Ready to serve soup packaging
   - Condensed soup packaging
4. Key takeaway messages
Soup Packaging LCA Conducted by Franklin Associates, a Division of ERG

Franklin Associates

- Founded by original developers of LCI methodology in the U.S.
- Continuous LCA practice for 40 years
- Instrumental in development of U.S. LCI Database; provided many key data sets (fuels, transport, resins and precursors)
- Extensive private database for U.S. processes and materials
Why Life Cycle Assessment?

- Ever-increasing demand and need for environmental information for sound decision-making
- Qualitative characteristics alone are not a sufficient basis for informed decision - need a quantified assessment of their effect on environmental profile
- LCA provides comprehensive set of quantified metrics – environmental “nutrition” label
- LCA identifies main contributors to environmental impacts for focusing improvement efforts
ISO Standards for LCA

Fundamental LCA guidance documents:
- ISO 14040: Principles and framework
- ISO 14044: Requirements and guidelines

ISO 14040 definition: LCA is the “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.”

ISO = International Organization for Standardization
Phases of an LCA
Four different phases of LCA are distinguished:

1. Goal and scope definition
2. Inventory analysis (LCI)
3. Impact assessment (LCIA)
4. Interpretation

Direct application:
- Product development and improvement
- Strategic planning
- Public policy making
- Marketing
- Other

Source: ISO 14040
Life Cycle Inventory

- Quantified inventory of flows to/from the environment for each system studied:
  - Raw materials, including water
  - Energy use (non-renewable and renewable)
  - Solid wastes
  - Atmospheric emissions
  - Waterborne emissions

- Can draw some conclusions from LCI, but emissions results can be difficult to interpret – many diverse emissions, mixed results
Life Cycle Impact Assessment

- How to interpret complex mix of emissions results in a meaningful way?
- Translate into potential impacts on the environment and human health:
  - Global warming potential, kg CO$_2$ eq
  - Acidification potential, kg SO$_2$ eq
  - Eutrophication potential, kg N eq
  - Smog formation potential, kg O$_3$ eq

*(Categories listed are those included in the Tetra Pak LCA)*
Global Warming Potential

- Metric describing the potential to contribute to increases in the average temperature of the Earth’s surface, caused by emissions of greenhouse gases

- Example air emissions: carbon dioxide, methane, nitrous oxide

- Expressed as kg CO$_2$ equivalents
Acidification Potential

- Accumulation of acidifying substances (SO$_2$, NOx) in the water particles suspended in the atmosphere ('acid rain')

- Deposited onto the ground by rains, these acidifying pollutants have a wide variety of adverse impact on soil, organisms, ecosystems and materials (buildings)

- Expressed as kg SO$_2$ eq
Eutrophication Potential

- The release of nutrients (phosphorus, nitrogen, BOD) to the aquatic and the terrestrial environment which can lead to a decrease in the oxygen content

- This impacts flora and fauna, and disturbs the ecosystems

- Expressed as kg N equivalents
Smog Formation Potential

- Smog formation is the photochemical creation of reactive substances (mainly ozone) which affect human health and ecosystems

- This ground-level ozone is formed in the atmosphere by nitrogen oxides (NOx) and volatile organic compounds (VOCs) in the presence of sunlight

- Expressed as kg O$_3$ equivalents
Soup Packaging LCA
Goal & Scope
Study Goal

- Provide Tetra Pak with life cycle impacts of Tetra Recart (TRC) cartons on the U.S. market compared to alternative soup packaging

- Containers evaluated in the LCA:
  - Ready-to-serve (RTS) soup:
    - 500 ml TRC compared to 18.6 oz (550 ml) steel can, 14.5 oz (429 ml) steel can, 500 ml laminate pouch
  - Condensed soup:
    - 340 ml TRC compared to 10.75 oz (318 ml) steel can
Functional Unit

- Containers within each category (RTS or condensed) are compared on a functional equivalence basis of 1,000 liters of prepared soup.
- Condensed soup diluted 1:1 with water, so 500 liters of packaged condensed soup per 1,000 liters of prepared soup.
- No comparisons made between RTS and condensed soup packaging systems.
System Boundaries

Legend
- Within System Boundaries
- Outside System Boundaries
- Step within transportation life cycle stage

Raw Material Extraction
- Material Production
- Converting
- Filling
- Retorting
- Retail
- Consumer Use
- End-of Life Disposal
- Recycling
- Secondary Packaging Production
- Secondary Packaging Disposal and Recycling
Critical Review and Use of Results

- The study has been peer reviewed and approved by an external panel of 3 LCA experts
  - Beth Quay, Former Director of Environmental Technical Affairs for Coca-Cola
  - Dr. Greg Keoleian, Director of the Center for Sustainable Systems at the University of Michigan
  - Dr. David Allen, Director of the Center for Energy and Environmental Resources at the University of Texas at Austin

- Peer review ensures compliance with ISO 14040/44 Standards for LCA
- Peer review allows public comparative assertions
Soup Packaging LCA: Study Findings for Ready-to-Serve
Normalized Summary Results: Ready to Serve
Ready to Serve Soup Packages

500 ml TRC
20 g

500 ml Laminate Pouch,
10.4 g

Steel cans

14.5 oz
(429 ml)
54.4 g

18.6 oz
(550 ml)
70.5 g
## RTS Container Components and Weights

### Weights in grams/container

<table>
<thead>
<tr>
<th></th>
<th>500 ml Tetra Recart</th>
<th>14.5 oz (429 ml) Steel Can</th>
<th>18.6 oz (550 ml) Steel Can</th>
<th>500 ml Pouch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Container</td>
<td>20.0</td>
<td>47.5</td>
<td>62.8</td>
<td>10.4</td>
</tr>
<tr>
<td>Closure (can lid)</td>
<td>6.90</td>
<td>7.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Container</strong></td>
<td><strong>20.0</strong></td>
<td><strong>54.4</strong></td>
<td><strong>70.5</strong></td>
<td><strong>10.4</strong></td>
</tr>
<tr>
<td>Corrugated Box/Tray</td>
<td>5.34</td>
<td>3.83</td>
<td>6.40</td>
<td>25.3</td>
</tr>
<tr>
<td>Shrink Film</td>
<td>1.26</td>
<td>1.87</td>
<td>1.33</td>
<td></td>
</tr>
<tr>
<td><strong>Total Weight, all components</strong></td>
<td><strong>26.6</strong></td>
<td><strong>60.1</strong></td>
<td><strong>78.2</strong></td>
<td><strong>35.7</strong></td>
</tr>
</tbody>
</table>
Ready to Serve Soup Packages (kg per 1,000 liters of soup)

500 ml TRC
39.9 kg

500 ml Laminate Pouch,
20.8 kg

Steel cans

14.5 oz (429 ml)
127 kg

18.6 oz (550 ml)
128 kg
TRC has lower total energy demand than steel cans, mainly due to lower material production energy.

Total energy similar for TRC and pouch; material energy higher for TRC, but pouch has much higher secondary packaging requirements.
Majority of energy for pouch and can systems is fossil (non-renewable) energy.

TRC has larger share of non-fossil energy, associated with biomass feedstock and process energy for paper content of the TRC rollstock.
Solid waste for TRC is dominated by postconsumer disposal
Material production wastes are highest for pouch and steel cans
At end-of-life, heavier weight of cans offset by high recycling rate
TRC has significantly lower GWP compared to other systems, with main advantage seen in material production stage.

End-of-Life negative value for TRC is from landfill carbon storage, while cans have credit for virgin steel production avoided by recycling.
Acidification impacts associated largely with SO$_2$ emissions from coal combustion (for electricity generation) and steel production.

TRC rollstock is produced in Europe with a low coal electricity grid.
Main eutrophication impacts for TRC and pouch due to water emissions from papermaking (TRC fiber, corrugated packaging)

Eutrophication for cans associated with can material production and recycling
- Majority of smog from nitrogen oxide emissions from fuel combustion
- TRC influenced by smog formation during ocean freighter transport of rollstock from Sweden to the U.S.
## RTS Comparative Conclusions Summary

<table>
<thead>
<tr>
<th>Meaningful Difference Threshold</th>
<th>Ready-to-Serve Soup Containers Compared to TRC 500 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pouch</td>
</tr>
<tr>
<td>Total Energy</td>
<td>10%</td>
</tr>
<tr>
<td>Fossil Energy</td>
<td>10%</td>
</tr>
<tr>
<td>Non-Fossil Energy</td>
<td>10%</td>
</tr>
<tr>
<td>Global Warming</td>
<td>25%</td>
</tr>
<tr>
<td>Acidification</td>
<td>25%</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>25%</td>
</tr>
<tr>
<td>Smog</td>
<td>25%</td>
</tr>
<tr>
<td>Total Solid Waste</td>
<td>10%</td>
</tr>
</tbody>
</table>

- Green = TRC results are notably lower compared to alternative
- Red = TRC results are notably higher compared to alternative
- Grey = No meaningful difference exists between systems
Soup Packaging LCA: Study Findings for Condensed
Normalized Summary Results: Condensed

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Normalized Summary Results:

- Condensed

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TRC 340 ml

10.75 oz can
Condensed Soup Packages

340 ml TRC
16 g

10.75 oz Steel Can
(318 ml)
41.2 g
### Condensed Soup Container Components and Weights

**Weights in grams/container**

<table>
<thead>
<tr>
<th>Component</th>
<th>500 ml Tetra Recart</th>
<th>14.5 oz (429 ml) Steel Can</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Container</td>
<td>16.0</td>
<td>35.6</td>
</tr>
<tr>
<td>Closure (can lid)</td>
<td></td>
<td>5.60</td>
</tr>
<tr>
<td><strong>Total Container</strong></td>
<td><strong>16.0</strong></td>
<td><strong>41.2</strong></td>
</tr>
<tr>
<td>Corrugated Tray</td>
<td>3.58</td>
<td>3.80</td>
</tr>
<tr>
<td>Shrink Film</td>
<td>0.84</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>Total Weight, all components</strong></td>
<td><strong>20.4</strong></td>
<td><strong>45.6</strong></td>
</tr>
</tbody>
</table>
Condensed Soup Packages
(kg per 1,000 liters of prepared soup)

- 340 ml TRC
  23.5 kg

- 10.75 oz Steel Can
  (318 ml)
  64.8 kg
TRC has lower total energy demand than steel can, mainly due to lower material production energy requirements for TRC.
Majority of energy for can system is fossil (non-renewable) energy

TRC has larger share of non-fossil energy, associated with biomass feedstock and process energy for paper content of the TRC rollstock
Solid waste for TRC is dominated by postconsumer disposal.

Material production wastes are much higher for steel cans, but end-of-life wastes lower due to high recycling rate for cans.
TRC has significantly lower GWP compared to steel cans, with main advantage seen in material production stage.

End-of-Life negative value for TRC is from landfill carbon storage, while can has credit for virgin steel production avoided by recycling.
- Acidification impacts associated largely with SO$_2$ emissions from coal combustion (for electricity generation) and steel production
- TRC rollstock is produced in Europe with a low coal electricity grid
Main eutrophication impacts for TRC due to water emissions from papermaking (TRC fiber content)

Eutrophication for cans associated with can material production and recycling
Condensed Soup Smog Formation Results by Life Cycle Stage

- Majority of smog from nitrogen oxide emissions from fuel combustion
- TRC influenced by smog formation during ocean freighter transport of rollstock from Sweden to the U.S.
**Condensed Soup Comparative Conclusions Summary**

<table>
<thead>
<tr>
<th>Description</th>
<th>Threshold</th>
<th>TRC Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Energy</td>
<td>10%</td>
<td>TRC lower</td>
</tr>
<tr>
<td>Fossil Energy</td>
<td>10%</td>
<td>TRC lower</td>
</tr>
<tr>
<td>Non-Fossil Energy</td>
<td>10%</td>
<td>TRC higher</td>
</tr>
<tr>
<td>Global Warming</td>
<td>25%</td>
<td>TRC lower</td>
</tr>
<tr>
<td>Acidification</td>
<td>25%</td>
<td>TRC lower</td>
</tr>
<tr>
<td>Eutrophication</td>
<td>25%</td>
<td>Insignificant</td>
</tr>
<tr>
<td>Smog</td>
<td>25%</td>
<td>TRC lower</td>
</tr>
<tr>
<td>Total Solid Waste</td>
<td>10%</td>
<td>TRC lower</td>
</tr>
</tbody>
</table>

- Green = TRC results are notably lower compared to alternative
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- Grey = No meaningful difference exists between systems
Tetra Recart Soup Packaging LCA Key Takeaway Messages
Summary Conclusions

- LCA is an important tool to understand the full environmental impact of different product systems.
- There can be trade-offs between Tetra Recart and other soup packaging systems depending upon the impact category examined.
- Overall, TRC shows benefits in most results compared to heavier steel can systems, despite the high recycling rate for cans.
- Comparative results are more mixed for TRC compared to soup pouches, which are about half the weight of TRC.
- TRC has a larger share of energy that is derived from renewable resources.
Depletion of Finite Natural Resources

- Tetra Recart contributes less to depletion of finite natural resources (fossil fuels)
  - TRC cartons are made of 68% paper, a renewable resource. As a result TRC results in less depletion of fossil fuel resources than steel cans and pouches on a lifecycle basis
  - Help secure sustainable supply for future growth
  - TRC consumes at least 50% less fossil energy than steel cans throughout the lifecycle and 35% less vs. lightweight pouches
Carbon Footprint Reduction

- Tetra Recart results in less greenhouse gas emissions than steel cans and pouches on a life cycle basis
  - 75% less greenhouse gas emissions vs. heavier steel can systems
  - 51% less GWP than lightweight flexible pouch system
Main Takeaway Messages

- TRC soup cartons perform favorably when comparing to heavier steel cans
  - Significantly lower total energy, fossil energy, solid waste, GWP, acidification, smog, and solid waste
  - TRC has higher non-fossil energy and mixed eutrophication results, associated with renewable fiber content of TRC

- Even when compared to significantly lighter pouches, TRC performs well in many areas
  - Lower fossil energy, GWP, acidification, and solid waste; comparable results for total energy, smog

- Study has been peer reviewed by a panel of 3 external experts, who have validated it was conducted according to ISO standards for LCA, so results can be shared